STATINTL

FINAL REPORT

for a

PANORAMIC STEREOVIEWER

SERIAL No. 586082-1

Rec'd in DB
 8 Sep 1966

PANORAMIC STEREOVIEWER

[redacted] Serial No. 586082-1

FINAL REPORT

Prepared

for

[redacted]

by

[redacted]

August 1966

1.0 PROJECT SUMMARY

Work was initiated on the project in July 1962. The first design problem developed in December 1962 when a search failed to disclose any facility that could grind and polish glass cylinders to the required specifications. Plastic cylinders were substituted in the design.

In May 1963 the contract was amended to add X and Y counters to the instrument to provide a measuring capability.

By June 1963 the assembly was completed sufficiently to make preliminary tests on the instrument. The following points were noted in these tests: Maintaining the film tension is very critical to avoid slippage of the film on the cylindrical stage. The plastic cylindrical stages were not acceptable due to the lack of resistance to abrasion. An investigation was made to determine if a hard coating such as SiO_2 could be deposited on the surface of the stages. Due to the lack of chemical and physical stability of plexiglass, it was not successful. Plans were initiated to develop the capability or find a source for grinding and polishing large cylinders in order to replace the plastic stages with glass. The manual drives were too slow and knurled knobs for the X and Y drives were not satisfactory. In addition to increasing the gear ratio, it was planned to replace the knobs with hand wheels. The anamorphic lenses used for field flatteners caused banding in the illumination. It was proposed to add a positive anamorphic lens, equal but opposite in power to that of the field flattener, to the condenser system to correct this condition. Tests of the motors for driving the film in X and tensioning the film on the cylindrical glass stages were found to be inadequate. The horsepower was not sufficient and the type of motor did not lend itself to the sensitive speed and torque control required. Work was initiated on a new motor and control system.

Considerable difficulty was encountered in obtaining glass stages for the instrument. Two subcontracts were negotiated. The first subcontract, which was awarded in July 1963, was cancelled in November 1963 after all four glass stage blanks had been broken either in grinding or polishing.

During the period of July through October 1963, the redesign and fabrication of the X film drive was completed. The motor drive was satisfactory, providing the desired speed control range with no apparent slippage of the film relative to the stage. The coefficient of friction between the film and the stage was sufficient for the film to drive the stage at the same surface velocity. However the manual drive mode was not successful, where it was intended to drive the stage and depend upon the coefficient of friction between the film and stage to pull the film from one spool to the other. The electrical characteristics of the torque motors and controllers used to tension the film on the stages were such that their torques increased beyond the balance which would be necessary to resist the unspooling of film. The coefficient of friction was not sufficient to overcome this unbalanced force; therefore, the film slipped relative to the stage when driving the stage.

On 7 February 1964 a stop work order was issued by
STATINTL [redacted] and no further charges were made to the project, pending a re-negotiation of the contract. A revision of the cost to complete depended on finding a source of supply for the glass stages and a solution to the problem of slippage in the manual drive. Under STATINTL [redacted] sponsorship, an investigation was made of a "closed loop" type film drive for the Panoramic Stereoviewer which would circumvent the problems with the film drive and film slippage. It would modify the existing design considerably and result in approximately 50% to 75% increase in cost of the viewer. At a presentation of this concept on 17 April 1964, the customer's representative indicated that this much change in scope could not be considered. It was requested that we investigate modifications to a somewhat relaxed specification: Smaller maximum film spool sizes - maximum of 500 feet, and less required correlation in the coupled drive mode - maintain alignment within 3 inches.

STATINTL

In April 1964, a subcontract was awarded by [redacted] for grinding and polishing four glass stages. Under this subcontract four glass stages were produced with the last stage being delivered in August 1964.

With the successful completion of the glass stages, a
STATINTL [redacted] proposal for modifying the film drive, with revised cost to complete the instrument, was submitted in September 1964. The proposed modification of the film drive was primarily mechanical and utilized most of the existing system. A breadboard of the proposed solution was completed and demonstrated, prior to submission of the proposal. The modification consisted basically of adding rubber coated rollers to increase the effective

coefficient of friction to assure that the film and the surface of the stage traveled at the same velocity. Also, the manual drive and X counters were gear connected to the friction rollers.

Approval of the proposal and additional funds to complete the instrument were received in February 1965. With the concurrance of the customer's representative, it was agreed not to start on the modification until April 1965 when the preferred designer for the project would be available. No further problems were encountered with the design concept; however, there were several delays waiting for purchased components. The instrument was completed, inspected and shipped on 14 December 1965.

2.0 DESIGN FEATURES OF THE INSTRUMENT

2.1 General Requirements

As the name of the instrument implies, the primary reason for the development was to make an instrument which would facilitate the viewing stereoscopically of photography taken with panoramic cameras. Since many panoramic cameras in use have relatively long focal lengths, the ratio of the air base to the flying height (B/H) would not be large enough for satisfactory stereoscopic perception with the camera mounted vertically and sweeping to the sides. To improve this ratio tandem cameras are used in a convergent configuration with one camera pointing forward and the other to the rear at approximately the same tilt angle. From widely separated exposure stations each of the cameras will photograph the same terrain and provide excellent stereoscopic perception.

With convergent photography, whether it is panoramic or frame, the scale of the imagery on the two exposures is different and varies across the formats. Therefore, it is necessary that the optical viewing systems have independent zoom magnification with sufficient range to provide the scale matching ratio required by the geometry and tilts of the photography to be viewed. A second requirement for the stereoscopic viewing of convergent panoramic photography is independent image rotation since the relative rotational orientation changes continuously when scanning the formats.

Finally, separate rolls of film are normally involved when viewing convergent panoramic or convergent frame photography;

therefore, separate mounts and drive systems are needed for the left and right stages.

2.2 Design Features and Operational Range

The instrument developed is a direct viewing instrument for stereoscopic examination of 70mm to 9½ inch roll film. It is capable of viewing vertical, convergent and oblique frame type photography and vertical and convergent panoramic photography. The viewing magnification is variable continuously from 2½X to 38X with a scale matching ratio of 3:1 between the right and left optical systems. Rotation prisms in the optical system permit the independent rotation of either the right or left image through 360 degrees.

A unique design feature of the instrument is the cylindrical glass stages for supporting the film for viewing. The film is tensioned over the cylindrical stage to keep it in contact with the stage for viewing. A field flattener in the optical system compensates for the curved object plane. When the film is translated in "X", the cylindrical stage rotates with the film, thereby avoiding any sliding contact between the stage and the film. Also, since the film is always in contact with the stage, it may be viewed in critical focus while being translated. The glass stage, film and film drive are on one carriage and are translated as a unit beneath the stationary optical system to scan the film in "Y".

The cylindrical stages may be driven independently or coupled together for scanning. Since the stages are on opposite sides of the instrument and have separate film drives, the two exposures forming the stereo pair must be on separate rolls of film. If the exposures to be viewed are on the same roll of negative film, as it is normally with vertical photography, duplicate positive film transparencies of the roll of film are required.

Both manual and motor drives are provided for transporting film. Maximum film speed is in excess of 200 feet per minute. Two types of illumination are provided. One is a high intensity system for use when viewing through the optical system and the other a general background illumination for direct viewing of the film on the cylindrical stages.

The instrument will accept all film spools up to the 1000 foot size; however, the motor drive and film tension control are adjusted for operation with a maximum film length of 500 feet.

3.0 DESIGN, EVALUATIONS AND RECOMMENDATIONS FOR IMPROVING THE INSTRUMENT CONCEPT

3.1 Cylindrical Stages

The use of cylindrical stages on a stereoscopic viewing instrument is unique. The concept is simple and provides the film with the greatest protection against damage when scanning. Since all parts of the viewer which come in contact with the film, including the stages, travel with the same surface velocity as the film, they cannot produce scratches on the film. In addition, a uniform tension may be maintained on the film at all times. From the standpoint of viewing, there is no pressure plate in the optical path to possibly degrade the image; and the film is in critical focus for viewing at highest magnification, even when it is moving. The optical field flattener maintains the image of the film on the curved stage in critical focus throughout the field of view of the optical system. From the mechanical point of view, the cylindrical stages permitted a very compact design free of complex mechanical linkages.

Based on the evaluation of the instrument design, it is recommended that cylindrical stages be considered for incorporation in the future on similar direct optical viewing instruments, where large quantities of roll film are to be scanned. A second application would be for a stage on a direct viewing light table for preliminary examination of film from photographic missions where large quantities of film are to be examined while scanning.

3.2 Film Drives

Both the motor and manual drives on the instrument serve their design functions. The manual drive provides the precise orientation required for stereoscopic viewing and slow scanning in stereo. The motor drive is for course positioning and slewing film. The "X" drive motors serve the dual function of tensioning the film on the cylindrical stage and transporting the film in "X".

It is recommended to improve the instrument concept that the pair of motors used to drive and tension the film be used only to tension the film. To drive the film a variable speed motor would be gear connected to the friction roller that is presently used for manually transporting the film. By separating the motor functions, a more precise control for tensioning and driving film can be obtained; thereby eliminating the need for a manual film drive. This would facilitate the operation of the instrument, simplify the electronic control for the drive system; and give a greater assurance of no slippage of the film relative to the stage or friction rollers.

Associated with these changes it is recommended that electronic counters be substituted for the mechanical counters and the flexible drives for them.

3.3 Optical System

Since this development was initiated, much improved optical systems have been developed with significantly higher resolving power and greater zoom range. It would be recommended to substitute our recently developed 7:1 zoom system. The same magnification range can be obtained with one less relay lens and the limiting resolution would be approximately doubled.